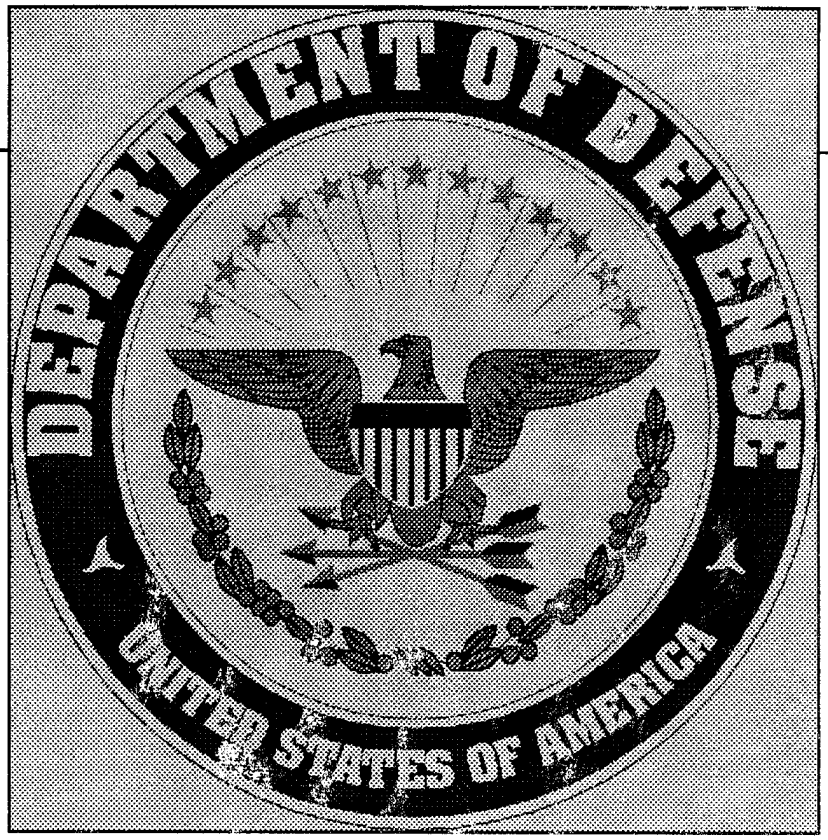

CAIS STANDARD MANUAL

SYSTEM NO. 31
SEWAGE
TREATMENT PLANTS

CAS PROJECT
CAIS MANUAL

Issued April 28, 1995

8 Mar 96

MEMORANDUM FOR DTIC-OCP
ATTN: Ms. Lue Lynch
8725 John J. Kingman Road, Suite 0944
Fort Belvoir, VA 22060-6218

FROM: AL/EQ (STINFO)
139 Barnes Drive. Suite 2
Tyndall AFB FL 32403-5323

SUBJECT: Transmision of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive. Suite 2
Tyndall AFB, FL 32403-5323

2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

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31 SEWAGE TREATMENT PLANTS

ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   - A. Level I Inspection Method Description
   - B. Level II Inspection Method Description
   - C. Level III Inspection Method Description

II. General Inspection
   - A. Process. This section describes the process of the inspection activity.
   - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications
   This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit
   This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs
   This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements
   This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools
   This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements
   This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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IX. Level II Inspection Method Keys
This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys
This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost
This section describes the nature and location of replacement cost data.

XII. Appendices
Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Sewage Treatment Plants.

INSPECTION METHODS

Description
Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements
Lists any special tools required for this specific subsystem.

Special Safety Requirements
This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List
All components to be surveyed under this subsystem are listed here.

Related Subsystems
All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

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Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method for Sewage Treatment Plants consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. Portions of the system may be inaccessible during the Level I inspection. Only readily accessible components need to be addressed during a Level I inspection. The Level I inspection is designed to be performed by one inspector.

B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being inspected. The Sewage Treatment Plant requires very few Level II inspections, since most defects are readily apparent from a Level I. For instance, the investigation of grinding noises in a pump may dictate that a Level II inspection be performed. Level II inspections are referenced by defect/observations through a "Level II key", which denotes a specific Guide Sheet that describes the Level II inspection activity.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 31-A provides the breakdown from system through component for the Sewage Treatment Plants. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information.

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If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

B. Location

Level I and II inspections will be located by the surveyor through a discrete entry in the Field CAIS. Building floor plans or sketches are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended room numbering schemes for the installation. The installation may have rooms physically identified by a numbering system or identified on floor plans. If both exist and are different, the Facility Manager will develop guidance on which numbering system takes precedence. Where numbering systems do not exist or are not complete in identifying each space, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Sewage Treatment Plants requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspector will be specifically trained in the CAS system and its usage and will be CAS certified in the "Civil" and "Mechanical" disciplines.

IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. The varied configurations of the components that exist in the Sewage Treatment Plants require that they be evaluated differently when defining the IU. Therefore, the measurement technique requires some consideration. If the inspector finds multiple defects that occur on the same IU, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component. The IU's for the most common components would be defined as follows:

- Piping, fittings and valves - The IU is defined as the linear footage of the affected section of pipe containing the defect in a particular location (to include the fittings and valves along that section). For example, five sections of 2" DIA pipe extend the length of a 20' wall within a mechanical room. If the inspector were to observe 2 LF of bent pipe on one 20 LF section, the IU would be 20 LF, not the total amount of 2" DIA pipe in the room of 100 LF.

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- Valve, Sump, etc. - The IU for singularly defined items such as these are defined as each.

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Pocket knife
Tape measure - 20' (or other supplemental measuring devices)
Screwdrivers - Phillips and straight slot
Pliers
Small container of ammonia (1/2 pint)

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

31 SEWAGE TREATMENT PLANTS

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Sewage Treatment Plants.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Sewage Treatment Plants.

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Appendix C - Life Cycles

A listing of the average life cycle duration for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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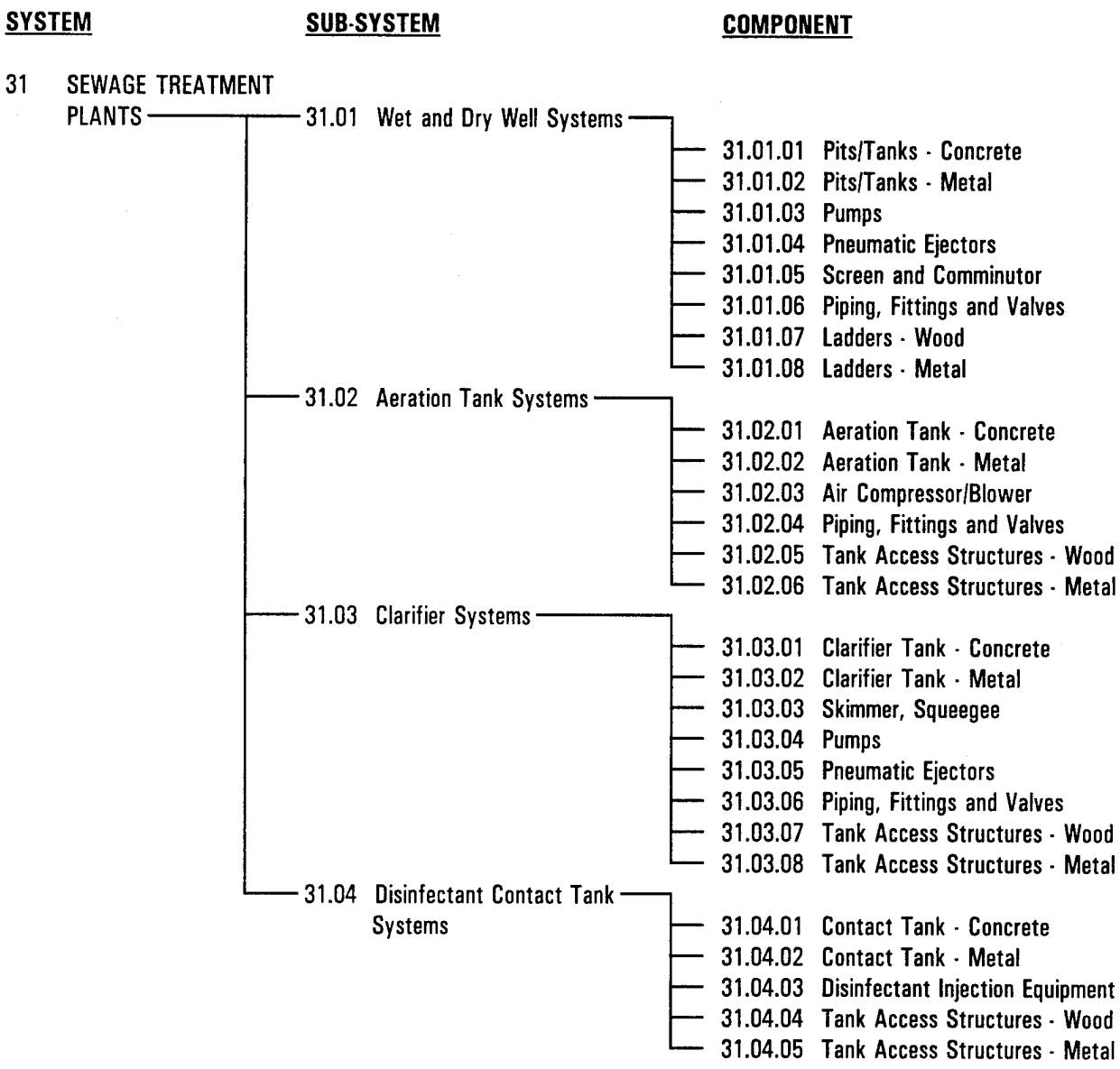
Figure 31-A. WORK BREAKDOWN STRUCTURE



31.01 WET AND DRY WELL SYSTEMS

DESCRIPTION

The Wet and Dry Well System is a subsystem of the Sewage Treatment Plant System. The wet wells or tanks are used to direct and/or balance the wastewater influent and may contain screening, grinding and pumping equipment. Dry wells or manholes are used to house pumps or ejectors to deliver wastewater to the sewage treatment facilities.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of the Wet and Dry Well Systems:

1. Paintbrush
2. Dye penetrant

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of the Wet and Dry Well Systems.

1. Inspectors should utilize the installation notification procedure to secure safe access to the sewage treatment plant.

COMPONENT LIST

- 31.01.01 PITS/TANKS - CONCRETE
- 31.01.02 PITS/TANKS - METAL
- 31.01.03 PUMP ASSEMBLY
- 31.01.04 PNEUMATIC EJECTORS
- 31.01.05 SCREEN AND COMMINUTOR
- 31.01.06 PIPING, FITTINGS, AND VALVES
- 31.01.07 LADDERS - WOOD
- 31.01.08 LADDERS - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

31.02 AERATION TANK SYSTEMS
31.03 CLARIFIER SYSTEMS
31.04 DISINFECTANT CONTACT TANK SYSTEMS

31.01 WET AND DRY WELL SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

a. Use Level I inspection method if HP is less than 5.
b. Use Level I & II inspection methods if HP is 5 to 40.
c. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized pump and motors applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include corrosion of metal tanks and other appurtenances, defective concrete structures, worn or damaged mechanical devices and uncontrolled vegetative growth on and around tank facilities.

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS

◆ 31.01.01 PITS/TANKS - CONCRETE

Concrete pits and tanks are rectangular or round pits and are usually placed underground to receive the wastewater influent.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Hairline cracks, non-structural, no groundwater intrusion.	SF		
*** {Severity L}			
b. Medium cracks, 1/16" wide, no groundwater intrusion.	LF		
*** {Severity M}			
c. Wide cracks more than 1/16" wide, obvious groundwater intrusion.	LF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.01 PITS/TANKS - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.02 PITS/TANKS - METAL

Metal pits and tanks are rectangular or round and are normally placed underground to receive the wastewater influent. Dry well floors are customary concrete for mounting of pumps, ejectors or accessories.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking or buckling.**			
Observation:			
a. Deformation, twisting, or bending of pit/tank walls and frame.	SF		
*** {Severity H}			
b. Stress or fatigue cracks in frame or wall.	SF		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Water dripping from pipe penetration through dry well wall.	EA		
*** {Severity L}			
b. Leaking gasket at manhole.	EA		
*** {Severity M}			
c. Leakage at other than manhole gasket.	EA		
*** {Severity H}			
d. Missing or damaged cover or grate.	SF		
*** {Severity H}			
*** Physical damage.**			
Observation:			
a. Abrasions on tank walls, no leaks.	SF		
*** {Severity L]			
b. Impact damage, dents, no leaks.	SF		
*** {Severity M}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.02 PITS/TANKS - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.03 PUMP ASSEMBLY

The wet and dry well pumps facilitate the movement of wastewater influent to the sewage plant treatment facilities. The pump unit includes pump, motor, drive, wiring and controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked or damaged pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Excessive pump noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	3
*** {Severity H}			
*** Broken/loose pump hardware.**			
Observation:			
a. Loose pump assembly or mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing pump assembly or mounting bolts.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking pump housing.	EA		
*** {Severity M}			
b. Leaking or damaged pump seals.	EA		
*** {Severity M}			
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.03 PUMP ASSEMBLY (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	4
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	4
*** {Severity H}			
c. Electrical arcing noise.	EA		4
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.03 PUMPS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Pump drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
*** Float control hardware defects.**			
Observation:			
a. Loose deformed or binding linage.	EA		
*** {Severity M}			
b. Inoperable float control mechanism.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.04 PNEUMATIC EJECTORS

Pneumatic ejectors are frequently utilized in place of pumps to facilitate the movement of wastewater influent from the wet well or collection sumps to the sewage plant treatment facilities. The most common ejectors use compressed air as a prime mover.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Ejector control system and valve defects.**			
Observation:			
a. Control system failure.	EA		
*** {Severity H}			
b. Defective pneumatic valve.	EA		
*** {Severity H}			
c. Loss of air pressure.	EA		
*** {Severity F}			
*** Ejector tank defects.**			
Observation:			
a. Loose inspection cover.	EA		
*** {Severity M}			
b. Physically damaged tank.	EA		
*** {Severity M}			
c. Missing or damaged access cover.	EA		
*** {Severity H}			
d. Waste water/air leaking from fittings.	EA		
*** {Severity H}			
e. Leaking gaskets.	EA		
*** {Severity H}			
*** Air compressor defects.**			
Observation:			
a. Cracked air compressor housing.	EA		
*** {Severity H}			
b. Broken or damaged air compressor base.	EA		
*** {Severity H}			
*** Damaged compressor motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.04 PNEUMATIC EJECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Broken/loose compressor motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	5
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	2	5
*** {Severity H}			
c. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.04 PNEUMATIC EJECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Compressor drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Missing coupling or belt guard.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.05 SCREEN AND COMMINUTOR

The screen and/or comminutor remove or shred large solids from the wastewater influent to prevent clogging of pumps or piping as the sewage proceeds through the treatment facilities. The screens consist of steel bars or wire screens and the comminutor is a motorized steel drum with cutting blades and slotted walls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Bars or screen defects.**			
Observation:			
a. Openings greater than 2 inches for less than or equal to 10 percent area.	SF		
*** {Severity M}			
b. Openings greater than 2 inches for greater than 10 percent area.	SF		
*** {Severity H}			
*** Comminutor drum defects.**			
Observation:			
a. Openings greater than 1/2 inches for less than or equal to 10 percent area.	SF		
*** {Severity M}			
b. Openings greater than 1/2 inches for less than or equal to 10 percent area.	SF		
*** {Severity H}			
c. Unusual sound from drum, indicating possible bearing failure.	EA		
*** {Severity H}			
*** Comminutor cutter blade defects.**			
Observation:			
a. Cutter blades deformed, missing or broken, affecting less than or equal to 10 percent of total.	EA		
*** {Severity L}			
b. Cutter blades appear dull, tearing solids versus cutting.	EA		
*** {Severity M}			
c. Cutter blades deformed, missing or broken, affecting greater than 10 percent of total.	EA		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.05 SCREEN AND COMMINUTOR (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Comminutor motor defects.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Comminutor motor hardware defects.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive comminutor motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	3	6
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	3	6
*** {Severity H}			
c. Electrical arcing noise.	EA		6
*** {Severity H}			
*** Defective comminutor electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.05 SCREEN AND COMMINUTOR (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Comminutor motor drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.06 PIPING, FITTINGS AND VALVES

Piping, fittings and valves provide the conduit necessary to transfer the wastewater through the wet and dry wells and to the treatment facilities. They also provide a means of route selection and isolation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	LF		
*** {Severity M}			
c. Missing insulation.	LF		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.06 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem, valve inoperable.	EA		
*** {Severity H}			
* **Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.07 LADDERS - WOOD

Wood ladders provide access to wet and dry wells from the surface. The side rails are normally 18" apart and the rungs 1' on center. The ladder is mounted on the well wall.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			
*** Splits, physically damaged.**			
Observation:			
a. Broken, split or physically damaged rungs or rails.	EA		
*** {Severity H}			
b. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" diameter, surface sag, and frass observed.	LF		
*** {Severity M}			
b. Holes greater than 1/8" diameter, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

COMPONENTS (Continued)

◆ 31.01.08 LADDERS - METAL

Metal ladders provide access to wet and dry wells from the surface. The side rails are normally 18" wide and the rungs 1' on center. The ladder is mounted to the well wall.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Missing or loose bolts or fasteners.	EA		
*** {Severity H}			
b. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Cracks or deformation.**			
Observation:			
a. Impact damage, dents.	LF		
*** {Severity M}			
b. Stress or fatigue cracks.	LF	4	
*** {Severity H}			
c. Cracked or broken welds.	LF	4	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

31.01 WET AND DRY WELL SYSTEMS

REFERENCES

1. Virginia Department of Environmental Quality "Wastewater Treatment Plant Operator Inspector Training Seminar"

2. "Sewage Treatment" Imhoff, Fair, 1966

3. Virginia State Water Control Board, Bureau of Applied Technology, "Package Plants, 1935-76".

4. NAVFAC MO-322, Vol. I and Vol. II, "Inspection of Shore Facilities", 1993

31.01 WET AND DRY WELL SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 31.01.03-1
2	GS-II 31.01.04-2
3	GS-II 31.01.05-3
4	GS-II 31.01.08-4

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 31.01.01-1
2	GS-III 31.01.01-2
3	GS-III 31.01.03-3
4	GS-III 31.01.04-4
5	GS-III 31.01.04-5
6	GS-III 31.01.05-6

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-II 31.01.03-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump assembly.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-II 31.01.03-1

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, I988

2. Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, NAVFAC MO-209, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: PNEUMATIC EJECTORS
CONTROL NUMBER: GS-II 31.01.04-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the compressor and motor.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify operator personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe operation of compressor and motor.
2. Note any unusual noise or vibration from compressor or motor.
3. Shut down compressor and lock out the disconnect.
4. Remove coupling or belt guard.
5. Examine coupling for missing or damaged screw bolts or shock absorber.
6. Examine drive belts for wear and looseness.
7. Examine pulleys for ware, looseness or damage.
8. Examine drives for alignment.
9. Examine open motor ends or fans for dust or arcing.
10. Remove all inspection covers and examine visible compressor and motor interiors.
11. Turn compressor and motor by hand and determine which is causing noise.
12. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
13. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
14. Return compressor to normal service.

Recommended Inspection Frequency

Perform inspection when triggered by Level I inspection or other local factors such as problematic conditions.

References

1. Virginia Department of Environmental Quality "Wastewater Treatment Plant Operator Inspector Training Seminar"

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: SCREEN AND COMMINUTOR
CONTROL NUMBER: GS-II 31.01.05-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the comminutor motor.

Special Safety Requirements

No special safety requirements ar needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor and lock out the disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if openings or inspection cover plates are present.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Return motor to normal service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: LADDERS - METAL
CONTROL NUMBER: GS-II 31.01.08-4

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PITS/TANKS - CONCRETE
CONTROL NUMBER: GS-III 31.01.01-1

Application

This guide applies to the investigation of cracks in concrete pit/tank walls.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: PITS/TANKS - CONCRETE
CONTROL NUMBER: GS-III 31.01.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete walls and floors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.01.03-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.01.03-3

Inspection Actions (Continued)

15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2. Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.01.04-4

Application

This guide applies to the investigation of rattling, grinding and arcing noise from the motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements:

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify operating personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor.
4. Shut down motor and lock out disconnect.
5. Isolate unit mechanically.
6. Check rotor windings for dirt, moisture, physical damage, sings or overheating and loose fasteners.
7. Check comminutor/slip rings for loose parts, physical damage and wear.
8. Check interior shafting for signs of fatigue.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Reassemble motor.
11. Rotate motor shaft and check for binding and rubbing.
12. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
13. Ensure that all guards and covers have been reinstalled.
14. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Remove lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.01.04-4

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by a Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PNEUMATIC EJECTORS
CONTROL NUMBER: GS-III 31.01.04-5

Application

This guide applies to the investigation of rattling, grinding and arcing noise from the motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements:

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify operating personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor.
4. Shut down motor and lock out disconnect.
5. Isolate unit mechanically.
6. Check rotor windings for dirt, moisture, physical damage, sings or overheating and loose fasteners.
7. Check commutator/slip rings for loose parts, physical damage and wear.
8. Check interior shafting for signs of fatigue.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Reassemble motor.
11. Rotate motor shaft and check for binding and rubbing.
12. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
13. Ensure that all guards and covers have been reinstalled.
14. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Remove lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PNEUMATIC EJECTORS
CONTROL NUMBER: GS-III 31.01.04-5

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by a Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: SCREEN AND COMMINUTOR
CONTROL NUMBER: GS-III 31.01.05-6

Application

This guide applies to the investigation of rattling, grinding and arcing noise from the motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 5.
2. Use Level I & II inspection methods if HP is 5 to 40.
3. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements:

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify operating personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor.
4. Shut down motor and lock out disconnect.
5. Isolate unit mechanically.
6. Check rotor windings for dirt, moisture, physical damage, sings or overheating and loose fasteners.
7. Check commutator/slip rings for loose parts, physical damage and wear.
8. Check interior shafting for signs of fatigue.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Reassemble motor.
11. Rotate motor shaft and check for binding and rubbing.
12. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
13. Ensure that all guards and covers have been reinstalled.
14. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Remove lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: SCREEN AND COMMINUTOR
CONTROL NUMBER: GS-III 31.01.05-6

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by a Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

31.02 AERATION TANK SYSTEMS

DESCRIPTION

The Aeration Tank Systems is a subsystem of the Sewage Treatment Plant System. Raw wastewater enters the aeration tank where it is mixed with microorganisms by the action of diffused air that is pumped into the tank.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of the Aeration Tank Systems:

1. Paintbrush
2. Dye penetrant

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Aeration Tank Systems.

1. Inspectors should utilize the installations notifications procedure to secure safe access to the sewage treatment plant.

COMPONENT LIST

- 31.02.01 AERATION TANK - CONCRETE
- 31.02.02 AERATION TANK - METAL
- 31.02.03 AIR COMPRESSOR/BLOWER
- 31.02.04 PIPING, FITTINGS AND VALVES
- 31.02.05 TANK ACCESS STRUCTURES - WOOD
- 31.02.06 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

31.01	WET AND DRY WELL SYSTEMS
31.03	CLARIFIER SYSTEMS
31.04	DISINFECTANT CONTACT TANK SYSTEMS

31.02 AERATION TANK SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

a. Use Level I inspection method if HP is less than 5.
b. Use Level I & II inspection methods if HP is 5 to 40.
c. Use Level I, II and/or III inspection methods if HP is greater than 40.

For fans, blower assemblies in general use, Level I & II inspection methods will apply. No Level III inspection will be required.

The Facility Manager will specify the level of inspection required for specialized motors, fans, blowers or blower assemblies.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects to be noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment, unequal air distribution and inoperative foam spray nozzles.

COMPONENTS

◆ 31.02.01 AERATION TANK - CONCRETE

The concrete aeration tank provides a vessel for the mixing of air with raw sewage for biological stabilization of the waste material. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ 31.02.01 AERATION TANK - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	SF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	SF		
*** {Severity M}			
c. Surface cracked, steady fluid leakage.	SF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ 31.02.01 AERATION TANK - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

♦ 31.02.02 AERATION TANK - METAL

The metal aeration tank provides a vessel for the mixing of air with raw sewage for biological stabilization of the waste material. The tank is a steel structure usually mounted on a concrete foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ **31.02.02 AERATION TANK - METAL (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ 31.02.03 AIR COMPRESSOR/BLOWER

The compressor/blower provides pressurized air through diffusers or nozzles at the bottom of the aeration tank.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive compressor/blower noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	3
*** {Severity H}			
c. Clicking or slapping noise.	EA	1	3
*** {Severity H}			
*** Defective compressor/blower mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged hardware or supports.	EA		
*** {Severity M}			
c. Missing hardware or supports.	EA		
*** {Severity H}			
*** Leaking air tank, piping, fittings and valves.**			
Observation:			
a. Leaking valve packing glands/seals, evidenced by leaking air.	EA		
*** {Severity M}			
b. Damaged piping, fittings or valves.	EA		
*** {Severity H}			
c. Stress cracks in tank, evidenced by leaking air.	EA		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ **31.02.03 AIR COMPRESSOR/BLOWER (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Broken/loose compressor/blower assembly bolts.**			
Observation:			
a. Loose compressor or motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing compressor or motor assembly bolts.	EA		
*** {Severity H}			
*** Loose compressor/blower base.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity L}			
b. Missing base tie-down bolts or isolators.	EA		
*** {Severity H}			
*** Defective pressure gauge.**			
Observation:			
a. Broken gauge or gauge lens.	EA		
*** {Severity L}			
b. Leaking pressure gauge.	EA		
*** {Severity M}			
*** Damaged compressor/blower motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ 31.02.03 AIR COMPRESSOR/BLOWER (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Compressor/blower drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ 31.02.04 PIPING, FITTINGS AND VALVES

Piping, fittings and valves are used to transfer and route the aerated fluids to the various plant functions and to provide the water supply to the aeration tank foam control spray system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Spray system domestic water dripping.	EA		
*** {Severity L}			
c. Wastewater leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Spray system domestic water dripping.	LF		
*** {Severity L}			
c. Wastewater leaking.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ **31.02.04 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem, valve inoperable.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	LF		
*** {Severity M}			
c. Missing insulation.	LF		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ 31.02.05 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent. of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent. of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" DIA, surface sag, frass observed.	LF		
*** {Severity M}			
b. Large holes greater than 1/8" DIA, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ **31.02.05 TANK ACCESS STRUCTURES - WOOD (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity M}			
b. Broken, split, or damaged connections.	EA		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

COMPONENTS (Continued)

◆ 31.02.06 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	2	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	2	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

31.02 AERATION TANK SYSTEMS

REFERENCES

1. Virginia Department of Environmental Quality "Wastewater Treatment Plant Operator Inspector Training Seminar"

2. "Sewage Treatment" Imhoff, Fair, 1966

3. Virginia State Water Control Board, Bureau of Applied Technology, "Package Plants, 1935-76"

4. NAVFAC MO-322, Vol. I and Vol. II, "Inspection of Shore Facilities", 1993

31.02 AERATION TANK SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 31.02.03-1
2	GS-II 31.02.06-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 31.02.01-1
2	GS-III 31.02.01-2
3	GS-III 31.02.03-3

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: AIR COMPRESSOR/BLOWER
CONTROL NUMBER: GS-II 31.02.03-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the air compressor/blower.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe operation of compressor and motor.
2. Note any unusual noise or vibration from compressor or motor.
3. Shut down compressor and lock out the disconnect.
4. Remove coupling or belt guard.
5. Examine coupling for missing, damaged screws, bolts or shock absorbers.
6. Examine drive belts for wear and looseness.
7. Examine pulleys for wear, looseness or damage.
8. Examine drives for alignment.
9. Examine open motor ends or fans for dust or arcing.
10. Remove all inspection covers and examine visible compressor and motor interiors.
11. Turn compressor and motor by hand and determine which is causing noise.
12. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
13. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
14. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Means Facilities and Repair Cost Data 1994

2. Maintenance and operation of air compressor plants, NAVFAC MO-206, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 31.02.06-2

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: AERATION TANK - CONCRETE
CONTROL NUMBER: GS-III 31.02.01-1

Application

This guide applies to the investigation of cracks in concrete pit/tank walls.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: AERATION TANK - CONCRETE
CONTROL NUMBER: GS-III 31.02.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete walls and floors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: AIR COMPRESSOR/BLOWER
CONTROL NUMBER: GS-III 31.02.03-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the compressor.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe compressor and motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor bearings.
4. Shut down compressor and lock out disconnect.
5. Isolate unit mechanically.
6. Open and inspect compressor interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue.
8. Check compressor shafting for damage from packing/mechanical seal.
9. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
10. Rotate (cycle) shafting and check for distortion in shaft.
11. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
12. Close compressor.
13. Rotate (cycle) compressor to check for binding.
14. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
15. Check coupling for wear, damage and loose fasteners.
16. Check coupling for misalignment.
17. Reassemble compressor and motor.
18. Ensure that all guards and covers have been reinstalled.
19. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
20. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
21. Restore valving to normal position.
22. Remove lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: AIR COMPRESSOR/BLOWER
CONTROL NUMBER: GS-III 31.02.03-3

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

31.03 CLARIFIER SYSTEMS

DESCRIPTION

The Clarifier System is a subsystem of the Sewage Treatment Plant System. The clarifier or settling tank maintains the liquid from the aeration tank in a quiescent condition allowing the suspended solids to settle to the bottom or float to the surface where they are removed and returned to the aeration tank. The clear liquid is then passed on to the disinfectant contact tank for treatment.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of the Clarifier Systems:

1. Paintbrush
2. Dye penetrant

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of the Clarifier Systems.

1. Inspectors should utilize the installations notification procedure to secure safe access to the sewage treatment plant.

COMPONENT LIST

- 31.03.01 CLARIFIER TANK - CONCRETE
- 31.03.02 CLARIFIER TANK - METAL
- 31.03.03 SKIMMER, SQUEEGEE
- 31.03.04 PUMP ASSEMBLIES
- 31.03.05 PNEUMATIC EJECTORS
- 31.03.06 PIPING, FITTINGS AND VALVES
- 31.03.07 TANK ACCESS STRUCTURES - WOOD
- 31.03.08 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

31.01 WET AND DRY WELL SYSTEMS
31.02 AERATION TANK SYSTEMS
31.04 DISINFECTANT CONTACT TANK SYSTEMS

31.03 CLARIFIER SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

a. Use Level I inspection method if HP is less than 5.
b. Use Level I & II inspection methods if HP is 5 to 40.
c. Use Level I, II and/or III inspection methods if HP is greater than 40.

The Facility Manager will specify the level of inspection required for specialized pump and motors applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment, damaged or inoperable skimmer and squeegee systems and damaged pumps.

31.03 CLARIFIER SYSTEMS

COMPONENTS

◆ 31.03.01 CLARIFIER TANK - CONCRETE

The concrete clarifier tank provides a vessel for settlement or flotation of suspended solids that have escaped the aeration chamber/tank. The tank is a reinforced concrete structure on a concrete base/foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing. exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	SF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	SF		
*** {Severity M}			
c. Surface cracked, steady fluid leakage.	SF		1
*** {Severity H}			
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.01 CLARIFIER TANK - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.02 CLARIFIER TANK - METAL

The metal clarifier tank provides a vessel for the settlement of floatation of suspended solids that have escaped the aeration chamber/tank. The tank is a steel structure usually mounted on a concrete foundation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.02 CLARIFIER TANK - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.03 SKIMMER, SQUEEGEE

The skimmer and squeegee is a mechanical system that collects floating and settled solids for return to the aeration tank. The system contains flexible scrapers (flights) on a rotating mechanism in round tanks and on a conveyor mechanism in rectangular tanks.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Flight/scraper defects.**			
Observation:			
a. Worn flights adjusted to limit.	EA		
*** {Severity M}			
b. Damaged or torn flights, affecting less than or equal to 25 percent of the swept area.	EA		
*** {Severity M}			
c. Damaged or torn flights, affecting greater than 25 percent of the swept area.	EA		
*** {Severity H}			
*** Flight travel mechanism defects.**			
Observation:			
a. Loose or worn chain, sprockets and/or rollers, less than or equal to 10 percent metal loss or adjustable.	EA		
*** {Severity M}			
b. Loose or worn chain, sprockets and/or rollers, greater than 10 percent metal loss or not adjustable.	EA		
*** {Severity H}			
c. Misaligned sprockets and/or rollers.	EA		
*** {Severity H}			
d. Rattling or grinding noise indicating defective bearing mechanism.	EA		
*** {Severity H}			
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.03 SKIMMER, SQUEEGEE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	1	3
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	3
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ **31.03.03 SKIMMER, SQUEEGEE (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Drive mechanism defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.04 PUMP ASSEMBLIES

The clarifier pump facilitates the movement of settled sludge and floating scum back to the aeration tank for further treatment. The pump unit includes pump, motor, drive, wiring and controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump.**			
Observation:			
a. Cracked or damaged pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
*** Excessive pump noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	4
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	2	4
*** {Severity H}			
*** Broken/loose pump hardware.**			
Observation:			
a. Loose pump assembly or mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing pump assembly or mounting bolts.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking pump housing.	EA		
*** {Severity M}			
b. Leaking or damaged pump seals.	EA		
*** {Severity M}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ **31.03.04 PUMP ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged pump motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Broken/loose motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	2	5
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	2	5
*** {Severity H}			
c. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.04 PUMP ASSEMBLIES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Pump drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.05 PNEUMATIC EJECTORS

Pneumatic ejectors are frequently utilized in place of pumps to facilitate the movement of settled sludge and floating scum back to the aeration tank for further treatment. The most common ejectors use compressed air as a prime mover.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Ejector control system and valve defects.**			
Observation:			
a. Control system failure.	EA		
*** {Severity H}			
b. Defective pneumatic valve.	EA		
*** {Severity H}			
c. Loss of air pressure.	EA		
*** {Severity F}			
*** Ejector tank defects.**			
Observation:			
a. Loose inspection cover.	EA		
*** {Severity M}			
b. Physically damaged tank.	EA		
*** {Severity M}			
c. Missing or damaged access cover.	EA		
*** {Severity H}			
d. Waste water/air leaking from fittings.	EA		
*** {Severity H}			
e. Leaking gaskets.	EA		
*** {Severity H}			
*** Air compressor defects.**			
Observation:			
a. Cracked air compressor housing.	EA		
*** {Severity H}			
b. Broken or damaged air compressor base.	EA		
*** {Severity H}			
*** Damaged compressor motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.05 PNEUMATIC EJECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Broken/loose compressor motor hardware.**			
Observation:			
a. Loose motor assembly bolts.	EA		
*** {Severity L}			
b. Broken or missing motor inspection covers.	EA		
*** {Severity M}			
c. Broken or missing motor assembly bolts.	EA		
*** {Severity H}			
*** Excessive motor noise and vibration.**			
Observation:			
a. Rattling noise.	EA	3	6
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	3	6
*** {Severity H}			
c. Electrical arcing noise.	EA		6
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.05 PNEUMATIC EJECTORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Compressor drive defects.**			
Observation:			
a. Loose coupling fasteners.	EA		
*** {Severity M}			
b. Damaged coupling or drive shaft, still operable.	EA		
*** {Severity M}			
c. Torn or damaged coupling shock absorbers.	EA		
*** {Severity H}			
d. Loose, damaged or deformed coupling.	EA		
*** {Severity H}			
e. Missing coupling.	EA		
*** {Severity H}			
* **Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.06 PIPING, FITTINGS AND VALVES

Piping, fittings and valves provide the conduit necessary to transfer the wastewater to and from the clarifier, and also provide a means of route selection and isolation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water dripping.	EA		
*** {Severity M}			
c. Water streaming.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water dripping.	LF		
*** {Severity M}			
c. Water streaming.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	LF		
*** {Severity M}			
c. Missing insulation.	LF		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ **31.03.06 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking valve.**			
Observation:			
a. Leaking check valve.	EA		
*** {Severity L}			
b. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
*** Damaged valve.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem, valve operable.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Bent stem, valve inoperable.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.07 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" diameter, surface sag, and frass observed.	LF		
*** {Severity M}			
b. Holes greater than 1/8" diameter, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ **31.03.07 TANK ACCESS STRUCTURES - WOOD (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity L}			
b. Missing fasteners or anchorage.	EA		
*** {Severity M}			
c. Broken, split or damaged wood at connection site.	EA		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

COMPONENTS (Continued)

◆ 31.03.08 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	4	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	4	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

31.03 CLARIFIER SYSTEMS

REFERENCES

1. Virginia Department of Environmental Quality "Wastewater Treatment Plant Operator Inspector Training Seminar"

2. "Sewage Treatment" Imhoff, Fair, 1966

3. Virginia State Water Control Board, Bureau of Applied Technology, "Package Plants, 1935-76"

4. NAVFAC MO-322, Vol. I and Vol. II, "Inspection of Shore Facilities", 1993

31.03 CLARIFIER SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 31.03.03-1
2	GS-II 31.03.04-2
3	GS-II 31.03.05-3
4	GS-II 21.03.08-4

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 31.03.01-1
2	GS-III 31.03.01-2
3	GS-III 31.03.03-3
4	GS-III 31.03.04-4
5	GS-III 31.03.04-5
6	GS-III 31.03.05-6

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: SKIMMER, SQUEEGEE
CONTROL NUMBER: GS-II 31.03.03-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if openings or inspection cover plates are present.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Return motor to normal services.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-II 31.03.04-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump assembly.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify operator personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe operation of pump and motor.
2. Note any unusual noise or vibration from pump or motor.
3. Shut down pump and lock out the disconnect.
4. Remove coupling or belt guard.
5. Examine coupling for missing or damaged screw bolts or shock absorber.
6. Examine drive belts for wear and looseness.
7. Examine pulleys for ware, looseness or damage.
8. Examine drives for alignment.
9. Examine open motor ends or fans for dust or arcing.
10. Remove all inspection covers and examine visible pump and motor interiors.
11. Turn pump and motor by hand and determine which is causing noise.
12. If both are turning free replace guards and cover plates.
13. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
14. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
15. Return pump to normal service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

2. Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: PNEUMATIC EJECTORS
CONTROL NUMBER: GS-II 31.03.05-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the compressor and motor.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify operator personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe operation of compressor and motor.
2. Note any unusual noise or vibration from compressor or motor.
3. Shut down compressor and lock out the disconnect.
4. Remove coupling or belt guard.
5. Examine coupling for missing or damaged screw bolts or shock absorber.
6. Examine drive belts for ware and looseness.
7. Examine pulleys for ware, looseness or damage.
8. Examine drives for alignment.
9. Examine open motor ends or fans for dust or arcing.
10. Remove all inspection covers and examine visible compressor and motor interiors.
11. Turn compressor and motor by hand and determine which is causing noise.
12. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
13. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
14. Return compressor to normal service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Means Facilities and Repair Cost Data, 1994
2. NAVFAC MO-206, Maintenance and Operation of Air Compressor Plants, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 31.03.08-4

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: CLARIFIER TANK- CONCRETE
CONTROL NUMBER: GS-III 31.03.01-1

Application

This guide applies to the investigation of cracks in concrete pit/tank walls.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CLARIFIER TANK- CONCRETE
CONTROL NUMBER: GS-III 31.03.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete walls and floors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, 1994, Peter H. Emmons

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: SKIMMER, SQUEEGEE
CONTROL NUMBER: GS-III 31.03.03-3

Application

This guide applies to the investigation of grinding or arcing noise from the motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 15.
2. Use Level I & II inspection methods if HP is 15 to 60.
3. Use Level I, II and/or III inspection if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements:

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor.
4. Shut down motor and lock out disconnect.
5. Isolate unit mechanically.
6. Check rotor windings for dirt, moisture, physical damage, signs of overheating and loose fasteners.
7. Check commutator/slip rings for loose parts, physical damage and wear.
8. Check interior shafting for signs of fatigue.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Reassemble motor.
11. Rotate motor shaft and check for binding, rubbing.
12. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
13. Ensure that all guards and covers have been reinstalled.
14. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Remove lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: SKIMMER, SQUEEGEE
CONTROL NUMBER: GS-III 31.03.03-3

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by a Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.03.04-4

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

a. Use Level I inspection method if GPM is less than 40.
b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion; check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers (pistons) for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.03.04-4

Inspection Actions (Continued)

15. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section, required to perform the inspection of the pump.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988

2 Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.03.04-5

Application

This guide applies to the investigation of grinding or arcing noise from the motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 15.
2. Use Level I & II inspection methods if HP is 15 to 60.
3. Use Level I, II and/or III inspection if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements:

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor.
4. Shut down motor and lock out disconnect.
5. Isolate unit mechanically.
6. Check rotor windings for dirt, moisture, physical damage, signs of overheating and loose fasteners.
7. Check commutator/slip rings for loose parts, physical damage and wear.
8. Check interior shafting for signs of fatigue.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Reassemble motor.
11. Rotate motor shaft and check for binding, rubbing.
12. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
13. Ensure that all guards and covers have been reinstalled.
14. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Remove lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: PUMP ASSEMBLY
CONTROL NUMBER: GS-III 31.03.04-5

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by a Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

31.04 DISINFECTANT CONTACT TANK SYSTEMS

LEVEL III GUIDE SHEET - KEY NO. 6

COMPONENT: PNEUMATIC EJECTORS
CONTROL NUMBER: GS-III 31.03.05-6

Application

This guide applies to the investigation of grinding or arcing noise from the motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 15.
2. Use Level I & II inspection methods if HP is 15 to 60.
3. Use Level I, II and/or III inspection if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements:

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw.
3. Perform vibration analysis on motor.
4. Shut down motor and lock out disconnect.
5. Isolate unit mechanically.
6. Check rotor windings for dirt, moisture, physical damage, signs of overheating and loose fasteners.
7. Check commutator/slip rings for loose parts, physical damage and wear.
8. Check interior shafting for signs of fatigue.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Reassemble motor.
11. Rotate motor shaft and check for binding, rubbing.
12. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
13. Ensure that all guards and covers have been reinstalled.
14. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Remove lockout on disconnect and restore unit to service.

31.04 DISINFECTANT CONTACT TANK SYSTEMS

LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)

COMPONENT: PNEUMATIC EJECTORS
CONTROL NUMBER: GS-III 31.03.05-6

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by a Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. 2, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

31.04 DISINFECTANT CONTACT TANK SYSTEMS

DESCRIPTION

The Disinfectant Contact Tank System is a subsystem of the Sewage Treatment Plant System. The contact tank destroys disease producing organisms in the treated liquid from the clarifier tank by the injection of a disinfectant, usually chlorine. The facility includes a tank disinfectant, storage, measuring and regulating devices and injection devices.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are to perform the inspection of Disinfectant Contact Tank Systems.

1. A small container of ammonia (1/2 PT)
2. Paintbrush
3. Dye penetrant

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Disinfectant Contact Tank Systems.

1. Inspectors should utilize the installations notification procedure to secure safe access to the sewage treatment plant.

COMPONENT LIST

- 31.04.01 CONTACT TANK - CONCRETE
- 31.04.02 CONTACT TANK - METAL
- 31.04.03 DISINFECTANT INJECTION EQUIPMENT
- 31.04.04 TANK ACCESS STRUCTURES - WOOD
- 31.04.05 TANK ACCESS STRUCTURES - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

31.01 WET AND DRY WELL SYSTEMS
31.02 AERATION TANK SYSTEMS
31.03 CLARIFIER SYSTEMS

31.04 DISINFECTANT CONTACT TANK SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common defects noted include, cracked tank foundations, cracked/spalled concrete, rusting tank walls and mechanical equipment, damaged or inoperative disinfectant dispensing devices.

COMPONENTS

◆ 31.04.01 CONTACT TANK - CONCRETE

The concrete contact tank provides a vessel for the induction of a disinfectant into the treatment plant effluent prior to release to the environment. The tank is a reinforced concrete structure on a concrete base/environment.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, exposed reinforcing and/or piping deformed.	SF		
*** {Severity H}			
*** Cracking.**			
Observation:			
a. Surface cracking, no signs of tank leakage.	SF		
*** {Severity L}			
b. Surface cracked, stains indicating fluid seepage.	SF		
*** {Severity M}			
c. Surface cracked, steady flowing leakage.	SF		1
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.01 CONTACT TANK - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Spalling.**			
Observation:			
a. Not more than 1" deep or 6" in diameter.	SF		
*** {Severity L}			
b. More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of member.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		2
*** {Severity H}			
*** Scaling.**			
Observation:			
a. Loss of surface up to 1/2" deep, with exposure of coarse aggregates.	SF		
*** {Severity L}			
b. Loss of surface from 1/2" to 1" deep, with coarse aggregates clearly exposed.	SF		
*** {Severity M}			
c. Loss of surface exceeding 1" deep.	SF		
*** {Severity H}			
d. Exposure of reinforcing steel.	SF		2
*** {Severity H}			
*** Reinforcing steel corrosion.**			
Observation:			
a. Rusting/discoloration evident, cracks occurring parallel to reinforcement.	SF		2
*** {Severity H}			
*** Popouts.**			
Observation:			
a. Conical holes less than 5/8" in diameter.	SF		
*** {Severity M}			
b. Conical holes greater than 5/8" in diameter.	SF		
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.01 CONTACT TANK - CONCRETE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.02 CONTACT TANK - METAL

The metal contact tank provides a vessel for the induction of a disinfectant into the treatment plant effluent prior to release to the environment.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Foundation settlement.**			
Observation:			
a. Concrete foundation cracked, no visible effect on tank operation.	SF		
*** {Severity L}			
b. Concrete foundation cracked, reinforcing. exposed and/or piping deformed.	SF		
*** {Severity H}			
*** Shell physical damage.**			
Observation:			
a. Dents and abrasions, no leakage or visible effect on tank operation. on tank function.	SF		
*** {Severity L}			
b. Dents and abrasions, evidence of leakage (stains).	SF		
*** {Severity M}			
c. Dents and abrasions, steady fluid leakage.	SF		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners, evidence of leakage.	EA		
*** {Severity H}			
b. Cracked or broken welds, evidence of leakage.	EA		
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ **31.04.02 CONTACT TANK - METAL (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Deteriorated protective covering/corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	SF		
*** {Severity H}			
*** Excessive vegetation.**			
Observation:			
a. Vines, trees or shrubs obstructing access to tank.	SF		
*** {Severity M}			
b. Vines, trees or shrubs growing on or next to tank.	SF		
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.03 DISINFECTANT INJECTION EQUIPMENT

Disinfectant (chlorine) injection equipment includes cylinder storage, piping, metering, flow control and recording devices.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Cylinder storage defects.**			
Observation:			
a. Loose or missing cylinder securing devices, chain/straps.	EA		
*** {Severity M}			
b. Missing cylinder labeling.	EA		
*** {Severity M}			
c. Chlorine odor, indicating leaking cylinder valve.	EA	1	
*** {Severity H}			
d. Damaged or improper fusible plug in cylinder valve.	EA		
*** {Severity H}			
e. Debris or storage blocking access to cylinders or equipment.	EA		
*** {Severity S}			
*** Instrumentation/control defects.**			
Observation:			
a. Corroded flow control device, operable.	EA		
*** {Severity M}			
b. Corroded pressure gauge, operable.	EA		
*** {Severity M}			
c. Corroded recording device, operable.	EA		
*** {Severity M}			
d. Damaged, missing or inoperable flow control device.	EA		
*** {Severity H}			
e. Damaged, missing or inoperable recording device.	EA		
*** {Severity H}			
f. Chlorine odor indicating instrumentation leakage.	EA	1	
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.03 DISINFECTANT INJECTION EQUIPMENT (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Piping, fittings and valve defects.**			
Observation:			
a. Corrosion evident by minor pitting.	LF		
*** {Severity M}			
b. Corrosion evident by blistering, severe pitting.	LF		
*** {Severity H}			
c. Chlorine odor, indicating leak at fitting or valve.	LF		
*** {Severity H}			
d. Frayed or damaged flexible piping from cylinder to manifold piping.	LF		
*** {Severity H}			
e. Damaged or missing pipe insulation.	LF		
*** {Severity F}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.04 TANK ACCESS STRUCTURES - WOOD

Wood tank access structures include wooden stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage defects.**			
Observation:			
a. Wood surface fibers separated, less than or equal to 25 percent of the thickness affected.	LF		
*** {Severity M}			
b. Wood surface fibers separated, greater than 25 percent of the thickness affected.	LF		
*** {Severity H}			
c. Structural member deformed, broken or missing.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Rot, fungus or decay.**			
Observation:			
a. Moist stained area.	LF		
*** {Severity M}			
b. Discolored, soft or crushed area.	LF		
*** {Severity H}			
*** Parasite damage.**			
Observation:			
a. Holes less than 1/8" diameter, surface sag, and frass observed.	LF		
*** {Severity M}			
b. Holes greater than 1/8" diameter, surface channels, punctures, and crushing.	LF		
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.04 TANK ACCESS STRUCTURES - WOOD (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections/anchorage.**			
Observation:			
a. Loose connections/anchorage.	EA		
*** {Severity L}			
b. Missing fasteners or anchorage.	EA		
*** {Severity M}			
c. Broken, split or damaged wood at connection site.	EA		
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

COMPONENTS

◆ 31.04.05 TANK ACCESS STRUCTURES - METAL

Metal tank access structures include metal stairs, ladders, catwalks and handrails, providing access on, over and around the tank for inspection and maintenance.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage, cracking and buckling.**			
Observation:			
a. Impact damage, dents, bends, not affecting safety or function.	LF		
*** {Severity M}			
b. Deformation, twisting or bending from overload.	LF		
*** {Severity H}			
c. Stress or fatigue cracks in members.	LF	2	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Defective connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	EA	2	
*** {Severity H}			
c. Missing bolts or fasteners.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Missing protective coating (paint, galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by excessive loss of base metal.	LF		
*** {Severity H}			

31.04 DISINFECTANT CONTACT TANK SYSTEMS

REFERENCES

1. Virginia Department of Environmental Quality "Wastewater Treatment Plant Operator Inspector Training Seminar"

2. "Sewage Treatment" Imhoff, Fair, 1966

3. Virginia State Water Control Board, Bureau of Applied Technology, "Package Plants, 1935-76"

4. NAVFAC MO-322, Vol. I and Vol. II, Inspection of Shore Facilities, 1993

31.04 DISINFECTANT CONTACT TANK SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 31.04.03-1
2	GS-II 31.04.05-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 31.04.01-1
2	GS-III 31.04.01-2

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: DISINFECTANT INJECTION EQUIPMENT
CONTROL NUMBER: GS-II 31.04.03-1

Application

This guide applies to the investigation of chlorine leaks in piping and valves of the disinfectant injection equipment.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify responsible personnel and obtain permission to take unit out of service.
2. Do not enter enclosed chlorine area without another person being present as observer.
3. Do not breath deeply in the presence of chlorine gas.

Inspection Actions

1. Remove top from ammonia bottle and hold bottle in area to be entered. If white fumes are produced do not enter.
2. Hold open ammonia bottle near all pipe joints and valves. If white fumes are emitted, a leak of chlorine is apparent.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Virginia Department of Environment quality Wastewater Treatment Plant Operator "Inspector Training Seminar"

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: TANK ACCESS STRUCTURES - METAL
CONTROL NUMBER: GS-II 31.04.05-2

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: CONTACT TANK - CONCRETE
CONTROL NUMBER: GS-III 31.04.01-1

Application

This guide applies to the investigation of cracks in concrete contact tank walls.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check general appearance for any conditions that may cause cracking or surface deterioration.
2. Examine cracking to determine if cracks are active or dormant. Document the location, pattern, depth, width and length.
3. Perform NDT, in this case ultrasonic pulse velocity inspection of the cracks to determine extent of subsurface damage.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Ultrasonic pulse velocity equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter Emmons, 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CONTACT TANK - CONCRETE
CONTROL NUMBER: GS-III 31.04.01-2

Application

This guide applies to the investigation of corrosion of reinforcing steel in concrete walls and floors.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Check for exposure and environmental conditions, specifically chemical attack. Document conditions.
2. Check for adequacy of concrete cover to protect it from corrosion. Document location and thickness of cover.
3. Perform NDT to determine corrosion activity, in this case a copper sulfate half-cell. These readings are taken on a grid basis and converted into potential gradient mapping.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Half-cell test equipment

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Concrete Repair and Maintenance, Peter H. Emmons, 1994

APPENDIX A

ABBREVIATIONS

AIC	American Institute of Chemists
CAIS	Condition Assessment Information System
CAS	Condition Assessment Survey
CERL	Construction Engineering Research Laboratory
DCD	Data Collection Device
DIA	Diameter
EA	Each
FT	Foot
GPM	Gallons Per Minute
GS	Guide Sheet
HP	Horsepower
HR.	Hour
IE	That is
IU	Inspection Unit
LF	Linear Foot
N/A	Not Applicable
NAVFAC-MO	Naval Facilities Maintenance and Operations
NDT	Non-Destructive
OS&Y	Outside Stem and Yoke
PE	Professional Engineer
PM	Preventive Maintenance
PVC	Polyvinyl Chloride

APPENDIX A

RPIL	Real Property Inventory List
SF	Square Foot
TM	Technical Manual
UOM	Unit Of Measurement
YRS	Years
WBS	Work Breakdown Structure
°	Degrees of Temperature
°C	Degrees Centigrade
°F	Degrees Fahrenheit
=	Equals
'	Feet
>	Greater Than
≥	Greater Than or Equal To
"	Inches
<	Less Than
≤	Less Than or Equal To
/	Per or Over
%	Percent
+	Plus or Positive or Add
±	Plus or Minus
–	Subtract or Minus or Negative
·	Times or By
x	Times or By

APPENDIX B

GLOSSARY

Abrasions	A scraping or rubbing off, as of skin. A wearing away by rubbing or scraping, as of rock by wind and water.
Aeration Tank	A vessel designed to expose a substance to air, or cause air to circulate through it, usually by mechanical means.
Aggregate	An inert granular material such as natural sand and gravel which when bound together into a mass by a matrix forms concrete or mortar.
Appurtenances	Apparatus or equipment; accessories for a specific system.
Barminutor	A grinding unit that has both a bar screen and a revolving drum with cutters. Large objects catch on the screen; then the revolving drum moves up and down on the face of the screen, shredding the objects until they are small enough to pass through.
Bearings	The support for a shaft, axle, or trunnion used to mediate friction; usually in conjunction with a lubricant.
Belt Guard	A shield or cage used to keep objects or persons from coming in contact with the moving equipment.
Blower	A fan usually one for heavy-duty application, e.g. a fan that forces fresh air through a duct system.
Brackets	Any angle-shaped support, especially those in the form of a right angle. A wall fixture as for a small electric lamp. An architectural support projecting from a wall.
Buckling	Bending, warping or crumpling as under pressure or in intense heat.
Catwalk	A narrow fixed walkway providing access to an otherwise inaccessible area or to a piece of equipment for service; used above an excavation, drydock, or high building.
Chain	A flexible series of joined links, usually of metal, used to pull, confine, or to transmit power; bonds; shackles.
Centrifugal	Moving or tending to move away from a center (conveying away from a center).

APPENDIX B

Chlorination	The addition of small amounts of free chlorine to water for the purpose of killing harmful organisms.
Clarifier	After screening and grit removal, the wastewater still contains settlable and floatable solids. These particles can be removed by greatly reducing the wastewater's speed of flow. This is what happens during the process of primary sedimentation often called clarification.
Comminutor	A grinding unit with a rotating drum that is placed in the wastewater flow. As the drum rotates, the wastewater flows through slots in the drum. When the particles are small enough they too pass through the slots.
Commutator	That part of a direct-current motor or generator which serves the dual function, in combination with brushes, of providing an electrical connection between the rotating armature winding and the stationary terminals, and of permitting reversal of the current in the armature windings.
Compressor	A machine for compressing air or other gases.
Concrete Cracks	Hairline cracks are defined as shallow cracks that are the width of a human hair, normally occur in a random pattern and result in no loss of surface. Medium and larger cracks can be larger than a hairline size and normally follow a pattern and result in surface loss.
Conduit	A tube or pipe used to protect electric wiring. A tube or pipe used for conveying fluid.
Conical	Resembling or shaped like a cone (a solid with a circle for its base and a curved surface tapering evenly to an apex so that any point on this surface is in a straight line between the circumference of the base and its apex.
Connectors	In an electrical circuit, a device for joining two or more conductors, by a low-resistance path, without the use of a permanent splice.
Corrosion	The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, or chemicals, or other agents in the environment in which it is placed.

APPENDIX B

Coupling	A metal collar with internal threads used to connect two sections of threaded pipe. The mechanical fastening that connects shafts together for power transmission.
Cycle	A period of time within which a round of regularly recurring events or phenomena is completed.
Cylinder	A solid figure described by the edge of a rectangle rotated around the parallel edge as axis: the ends of the cylinder are parallel and equal circles. Anything having the shape of a cylinder, whether hollow or solid. Specifically, the chamber in which the piston moves in a reciprocating engine; the barrel of a pump; a container used to hold and transport compressed gas for various pressurized applications.
Decay	A deterioration or decomposing as of vegetable matter.
Deformation	Any change of form, shape, or dimensions produced in a body by a stress or force, without a breach of the continuity of its parts.
Diaphragm	A separating wall or membrane, especially one which transmits some substances and forces but not others. In general, any opening, sometimes adjustable in size, which is used to control the flow of a substance or radiation.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Diffused	Spread out or dispersed; not concentrated; spread or scattered widely. Mixed by diffusion.
Disinfectant	Anything that disinfects; means for destroying harmful bacteria, viruses, etc..
Drive	The means by which a machine is given power or motion (as in steam drive or diesel-electric drive), or by which power is transferred from one part of an engine to another (as in gear drive or belt drive).
Drive Shaft	A shaft which transmits power from a motor or engine to the rest of a machine.
Drum	A metal spool or cylinder around which cable etc. is wound in a machine. A barrel-like metal container for oil etc.
Dry Wells	Compartment of a pumping station in which the pumps are

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	housed (similar to a manhole).
Dye Penetrant	A liquid with low surface tension, containing a dye or florescent chemical; which when flowed over a metal surface, is used to determine the existence and extent of cracks and other discontinuities.
Effluent	The liquid waste of sewage and industrial processing. Flowing outward or away from. Liquid which flows away from a containing space or a main waterway.
Ejectors	A pumping device used to lift sewage to a higher elevation.
End Bells	A hollow metal cylinder closed at one end and flared at the other. A conical device that seals the top of a blast furnace.
Erosion	The deterioration brought about by the abrasive action of fluids or solids in motion.
Fans	A radial or axial flow device used for moving or producing artificial currents of air.
Fan: Axial	A fan that produces pressure from the velocity of air passing through the impeller, with no pressure being produced by centrifugal force.
Fan: Centrifugal	A fan within a scroll-type housing, which receives air perpendicular to the axis of rotation and discharges it radially; by pushing it away from the center of rotation; may be either belt driven or connected directly to a motor. A fan rotor or wheel within a scroll type of housing including driving mechanism supports for either belt drive or direct connection.
Fan: Propeller	A propeller or disc-type wheel within a mounting ring or plate including driving mechanism supports for either belt drive or direct connection.
Fatigue	The tendency of a metal or other material to crack and fail under repeated applications of stress.
Fitting	A pipe part, usually standardized, such as a bend, coupling, cross, elbow, reducer, tee, union, etc.; used for joining two or more sections of pipe together. The term usually is used in the plural. An accessory such as a bushing, coupling, locknut, or other part of an electric wiring system which is intended to perform a mechanical rather than an electrical function.

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Float	Anything which stays or causes something else to stay, on the surface of a liquid or suspended near the surface. A floating ball or device that regulates the valve controlling water level.
Fungus	Any of a large group, including molds, mildews, mushrooms, rusts, and smuts, which are parasites on living organisms or feed upon dead organic material, lack chlorophyll, true roots, stems, leaves, and reproduce by means of spores.
Fusible Plug	A protective device used on a heated pressure vessel (for example a steam boiler), and containing a material that melts at a predetermined safe temperature to prevent the buildup of excessive pressure.
Gaskets	A continuous strip of resilient material attached to a panel or frame to provide a tight seal between the frame and the panel. Any ring of resilient material used as a joint to prevent leakage.
Gauges	A standard measure or scale of measurement; dimensions, capacity, thickness. Any device for measuring something as the thickness of wire, the dimensions of a machined part, the amount of liquid in a container, steam pressure, etc.
Grate	A framework of parallel or latticed bars set in a window, door, floor, etc.; design to keep out unwanted items but let air, light, and water, through.
Grinding	To crush into bits or fine particles between two hard surfaces; pulverize.
Half-cell Potential Test	In electrochemical cells, the electrical potential developed by the overall cell reaction; can be considered, for calculation purposes, as the sum of the potential developed at the anode and the potential developed at the cathode, each being a half-cell. This difference in potential can be detected by placing a copper/ copper sulfate half-cell on the surface of the concrete and measuring the potential differences between the reinforcing steel and a wet sponge on the concrete surface. The reference cell connects the concrete surface to a high-impedance voltmeter, which is also connected electrically to the reinforcing steel mat.
Housing	In a pump, motor, or fan the casing or enclosure which contains the parts of the piece and acts to protect the enclosed machinery.

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Impellers	The rotating member of a fan, turbine, blower, axial or centrifugal pump, or mixing apparatus. Also known as a rotor.
Influent	An input stream of a fluid, as water into a reservoir, or liquid into a process vessel. The raw sewage entering a treatment plant.
Infrared Temperature Tester	An instrument that focuses and detects the infrared radiation (heat energy) emitted by an object in order to determine its temperature.
Isolate	To set apart from others; place alone. To separate (an element or compound) in pure form from substances with which it is combined or mixed.
Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.
Manholes	A covered opening which provides access for cleaning and repairing, in an underground pipe system.
Manifold	A section of pipe with a number of branches close together.
Microorganisms	Any of the bacteria, protozoans, viruses.
Motors	Anything that produces or imparts motion; an engine especially an internal-combustion engine. A machine for converting electrical energy to mechanical energy.
Nozzles	A tube-like device, usually streamlined, for accelerating and directing a fluid, whose pressure decreases as it leaves the device.
Packing Glands	Packing is the stuffing or elastic material around a shaft or valve stem or around a joint to prevent leakage. A stuffing box surrounds a shaft to prevent leakage by the use of packing; commonly used on water pumps; the packing gland is a movable part that compresses the packing in the stuffing box.
Parasites	A plant or animal that lives on or in an organism of another species from which it derives sustenance or protection without benefitting the host and usually doing harm.

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Penetration	The opening through a wall or floor designed to allow the passage of a pipe or duct.
Pistons	A disk or short cylinder closely fitted in a hollow cylinder and moved back and forth by the pressure of a fluid so as to transmit reciprocating motion to the piston rod attached to it, or moved by the rod to exert pressure on the fluid.
Pit	An area below floor or ground level.
Plumb	Exactly vertical.
Pneumatic	Pertaining to or operated by air or other gas.
Pop-outs	A conical fragment that has broken out of the surface of the concrete leaving small holes. Generally a shattered aggregate particle will be found at the bottom of the hole, with a part of the fragment still adhering to the small end of the pop-out cone. Pop-outs are caused by reactive aggregates and high alkali cement. They are also caused by aggregates such as shale, which expand with moisture.
Pulleys	A wheel having a grooved rim for carrying a rope or other line and turning in a frame.
Pumps	A machine that draws a fluid into itself through an entrance port and forces the fluid out through an exhaust port. A motor driven device used to mechanically circulate fluid in a system; also called a circulator.
Rattling	A quick succession of sharp short sounds.
Rivets	A short pin, of a malleable metal such as iron, steel, or copper, with a head at one end; used to unite two metal plates by passing it through a hole in both plates and then hammering down the point to form a second head.
Roots Blower	A compressor in which a pair of hourglass-shaped members rotate within a casing to deliver large volumes of gas at relatively low pressure increments.
Rot	Decomposition in wood by fungi and other microorganisms; reduces the strength, density, and hardness.

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Rotor	The rotating member of an electrical machine or device such as the rotating armature of a motor or generator or the rotating plates of a variable capacitor.
Rungs	Any sturdy stick, bar, or rod, especially a rounded one, used as a crossbar or support; any of the crosspieces constituting the steps of a ladder.
Run-out Play	This term generally applies to the horizontal of branch circuits or the measurement of play in a bearing or shaft.
Sag	To sink, bend, or curve, especially in the middle, from weight or pressure.
Scaling	The process of the corrosion of metals. A heavy oxide coating resulting from exposure to high temperatures in an oxidizing atmosphere. A weighing device.
Seals	A tight closure as against the passing of air and water, something that closes or fastens tightly or securely.
Settling Tanks	After screening and grit removal, the wastewater still contains settlable and floatable solids. These particles can be removed by greatly reducing the wastewater's speed of flow. This is what happens during the process of primary sedimentation often called clarification. The place where this takes place can be called a clarifier or a settling tank.
Shaft	A bar or cylinder supporting or transmitting motion to a mechanical part.
Shell	A thin hollow cylinder; the outer wall of a vessel or tank.
Skimmer	A device used to collect and remove the scum from the surface of the water in a primary clarifier.
Spalling	A roughly circular or oval depression in the concrete. Spalls result from the separation and removal of a portion of the surface concrete, revealing a fracture roughly parallel to the surface. Spalls can be caused by corroding reinforcement steel and friction from thermal movement; reinforcing steel is often exposed.
Sprockets	Any of a number of teeth or points,as on the rim of a wheel, arranged to fit into the links of a chain. A wheel fitted with sprockets on its outside.

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Squeegee	Blades attached to the arms of a circular clarifier that reach out along the floor from the center of the tank to the walls; scraping the sludge toward the center of the floor.
Stress	Force exerted upon a body, that tends to strain or deform its shape; strain or straining force.
Structural Members	One of a number of units which when assembled together becomes an integral part of the entire building or structure.
Sumps	A pit, tank, basin, or receptacle which receives sewage or liquid waste, located below the normal grade of the gravity system, and which must be emptied by mechanical means. A reservoir sometimes forming part of a roof drain. A depression in a roof deck where the roof drain is located.
Ultrasonic Pulse Velocity Test	An ultrasonic detector is used either in scanning (non-contact) or in contact mode. The pulse velocity test uses the contact mode. A metal probe (transducer) supplied with the detector is stimulated by ultrasound and transmits the waves, when touched against equipment surfaces, to another detector. The velocity of this ultrasonic pulse is measured; the faster the pulse the more dense the material tested. The test can also detect and evaluate cracks, voids, delamination and other defects.
Valves	A device which regulates or controls the flow of a liquid or gas.
Vibration	Rapid, periodic, to-and-fro motion or oscillation of an elastic body or the particles of a fluid when displaced from the rest position or position of equilibrium, as in transmitting sound.
Voltage	Electromagnetic force, or difference in electrical potential, expressed in volts.
Weld	To unite metals by heating them to suitable temperatures, with or without the application of pressure, and with or without the use of filler metal.
Wet Wells	A chamber which is used for collecting liquid, and to which the suction pipe of a pump is attached.

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LIFE CYCLES

31 SEWAGE TREATMENT PLANTS

31.01 WET AND DRY WELL SYSTEMS

Wet Well - Concrete	30 YRS
Dry Well - Concrete	40 YRS
Wet and Dry Wells - Metal	25 YRS
Mechanical Equipment	15 YRS

Source:
Means Facilities Maintenance Manual, Roger W. Liska, PE, AIC, 1988

31.02 AERATION TANK SYSTEMS

Aeration Tank - Concrete	40 YRS
Aeration Tank - Metal	25 YRS
Mechanical Equipment	15 YRS

Source:
Means Facilities Maintenance Manual, Roger W. Liska, PE, AIC, 1988

31.03 CLARIFIER SYSTEMS

Clarifier Tank - Concrete	40 YRS
Clarifier Tank - Metal	25 YRS
Mechanical Equipment	15 YRS

Source:
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

31.04 DISINFECTANT CONTACT TANK SYSTEMS

Contact Tank - Concrete	40 YRS
Contact Tank - Metal	25 YRS
Disinfectant Injection System	15 YRS

Source:
Means Facility Maintenance Standards, Roger W. Liska, PE, AIC, 1988